Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

BE SEMESTER V • EXAMINATION – SUMMER • 2015

Subject Code: 150404 **Date:07/05/ 2015**

Subject Name: Principles of Process Engineering-II

Time:02.30pm-05.00pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**
4. **Notations used have their conventional meanings.**

Q.1 **(a)** Draw classification chart of mass transfer operations along with examples in each category. **07**

(b) State and explain Fick's first law for unidirectional molecular diffusion. Also, differentiate between two types of molar flux N_A and J_A and derive $J_A = - J_B$ for binary diffusion. **07**

Q.2 **(a)** Explain the concept of equilibrium and principles for interphase mass transfer between two insoluble phases. **07**

(b) State various theories used in mass transfer to explain meaning of mass transfer coefficients and explain any one theory in detail. **07**

OR

(b) In an O_2-N_2 gas mixture at 1 atm. pressure and 25°C, the concentrations of oxygen at two planes 2 mm apart are 10 and 20 volume % respectively. Calculate the flux of diffusion of O_2 for the case where, **07**

(i) N_2 is non-diffusing.

(ii)There is equimolar counter diffusion of the two gases.

Data: D_{O2-N2} at 25°C and 1 atm. = 2.065 x 10^{-5} m^2/s

Q.3 **(a)** Discuss various factors to be considered in making choice of solvent for liquid-liquid extraction. **07**

(b) If 1000 kg/h of a nicotine (C) - water (A) solution containing 1% nicotine is to be counter currently extracted with kerosene at 20^0C to reduce the nicotine content to 0.1% . Determine (i) the minimum kerosene rate and (ii) the number of theoretical stage required if 1150 kg of kerosene is used per hour. **07**

Sr. No.	x'	y'	Sr. No.	x'	y'
1	0	0	5	0.00751	0.00686
2	0.001011	0.000807	6	0.00988	0.00913
3	0.00246	0.001961	7	0.0204	0.01870
4	0.00502	0.00456			

x' : kg nicotine/ kg water and y': kg nicotine/ kg kerosene

Water and kerosene are essentially insoluble.

OR

Q.3 **(a)** Define liquid-liquid extraction (LLE). Give the usefulness of LLE in comparison with distillation. **05**

(b) A solution of nicotine in water containing 1% nicotine is to be extracted with kerosene at 293 K (20°C). Water and kerosene are essentially insoluble. Assume the equilibrium relationship to be: Y = 0.9 X **09**

Where,Y= kg nicotine/ kg kerosene

and X= kg nicotine/ kg water

(i) Determine the percentage extraction of nicotine if 100 kg of a feed solution is extracted with 150 kg of solvent (kerosene)
(ii) Repeat for three theoretical extraction using 50 kg solvent each time

Q.4	**(a)**	With neat sketch, explain Shanks system in leaching.	**07**
	(b)	Write a short note on absorption factor in case of gas absorption.	**07**
		OR	
Q.4	**(a)**	Discuss any equipment of leaching with neat diagram.	**07**
	(b)	Derive an expression of N_A for steady state molecular diffusion of liquid A through non-diffusing liquid B.	**07**
Q.5	**(a)**	Explain minimum Liquid-Gas ratio for absorbers with sketches	**07**
	(b)	Differentiate between direct and indirect mass transfer operations in detail	**07**
		OR	
Q.5	**(a)**	Explain criteria for choice of solvent for gas absorption.	**07**
	(b)	Explain gas absorption with chemical reaction.	**07**

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